

Manufacturing in Missouri:

Diversification and Specialization



RESEARCH AND PLANNING
Missouri Department of Economic Development

Manufacturing in Missouri: *Diversification and Specialization*

EXECUTIVE SUMMARY

- The manufacturing sector still constitutes an important part of local and regional economies in the United States, especially in rural areas. Given the nature of the global economy, policy-makers need to identify areas of economic comparative advantage that they can build upon; and areas of economic vulnerability that they need to strengthen.
- Missouri has a moderate to significantly diversified manufacturing base. Counties that have a fully diversified manufacturing base include Buchanan, Greene, Howell, Jasper, Lawrence, Pettis and St. Louis City. However, several counties are dependent upon one type of manufacturing, including Monroe, Putnam, Sullivan and Worth Counties.
- Between 1990 and 1999, the number of counties that are highly specialized in *top-of-cycle manufacturing* has increased - from 10 in 1990 to 16 in 1999. In 1999, top-cycle manufacturing employment was particularly concentrated in Boonville/Marshall, Clinton/Warrensburg, Missouri River valley, Hannibal/Macon, Joplin/Springfield, the Lake of the Ozarks, Maryville, the Missouri Bootheel, and suburban St. Louis.
- Between 1990 and 1999, the number of counties that are highly specialized in *bottom-of-cycle manufacturing* has decreased - from 57 in 1990 to 47 in 1999. In 1999, bottom-cycle manufacturing was concentrated in the east-central, southeast, south-central, and southwest regions of the state.
- Between 1990 and 1999, the number of counties that are highly specialized in *resource-based manufacturing* has remained stable - from 41 in 1990 to 40 in 1999. In both years, this type of manufacturing has concentrated around lumber and wood products in the southeast and south-central; food processing in the southwest; and agricultural and food processing in the central and northern portions of Missouri.
- Between 1990 and 1999, the number of counties that are highly specialized in *high-technology manufacturing* has increased - from 11 in 1990 to 16 in 1999. In 1999, high-tech manufacturing was concentrated in Chariton and Howard Counties, Hannibal, suburban St. Louis, Fulton, the Lake of the Ozarks, Springfield, and Popular Bluff .

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I. Overview

The decentralization of the manufacturing sector following World War II created an abundance of jobs across the United States, becoming one of the main economic sectors in the country. However, since the mid-1980s manufacturing has been declining in importance as firms begin to automate production and move operations abroad. Despite these trends, the manufacturing sector still constitutes an important part of local and regional economies in the United States, especially in rural areas. Therefore, it is imperative that policy-makers understand the strengths and weaknesses of their manufacturing base. Given the nature of the global economy, policy-makers need to identify areas of economic comparative advantage that they can build upon; and areas of economic vulnerability that they need to strengthen.

It is important to understand that manufacturing is a diverse industry in terms of both the products it produces and the labor skills it requires – it cannot be conceptualized as a homogenous sector. Different types of manufacturing produce different types of positive and negative externalities. For example, manufacturing firms that require a high degree of skilled technical labor may produce a more educated workforce, higher wages, and globally competitive jobs that are secure. In contrast, firms that require little or no skilled labor may produce a poorly educated workforce, lower wages, and jobs that are prone to be moved to low wage nations abroad. Therefore, it is important that policy-makers understand the types of manufacturing that exist in their area in order to assess potential economic and external effects.

Using established typologies from the United States Department of Agriculture¹ and the Center for Urban Policy Research², manufacturing industries were classified into four groups based on two-digit and three-digit Standard Industry Classifications (SICs): *top-of-cycle manufacturing*, *bottom-of-cycle manufacturing*, *resource-based manufacturing* and *high-technology manufacturing*. These groupings reflect the types of product cycles characterizing each sector. Each aggregate sector is defined below. Refer to the appendix for a complete definition, including SIC codes.

¹ Bloomquist, L.E. 1988. "Performance of the Manufacturing Sector". *Rural Development in the 1980s: Prospects for the Future*, edited by D.L. Brown. RD-69, Economic Research Service, U.S. Department of Agriculture. Washington, DC: GPO.

² Glasmeier, A.K. 1991. *The High-Tech Potential: Economic Development in Rural Areas*. New Brunswick, NJ: Center for Urban Policy Research.

Top-of-cycle manufacturing industries are those that typically require highly skilled technical labor. This includes the manufacturing of the following: printing and publishing products; chemicals and allied products; electrical machinery; machinery except electrical; transportation equipment except motor vehicles; and instruments and related products.

Bottom-of-cycle manufacturing industries are those that require assembly and materials handler labor for standardized production. This includes the manufacturing of the following: textile mill products; apparel and other textile products; furniture and fixtures; rubber and plastic products; leather and related products; stone, clay and glass products; primary metal products; fabricated metal products; motor vehicles and related equipment; and various other manufacturing industries.

Resource-based manufacturing industries are those that typically require access to natural resources or agricultural products. This includes the manufacturing of the following: food and kindred products; tobacco products; lumber and wood products; paper and allied products; and petroleum and coal products.

High-technology manufacturing industries are those that require an above average number of engineers, engineering technicians, computer scientists, mathematicians, and life scientists (including chemists and geologists). This includes the manufacturing of the following: industrial organic, inorganic, and agricultural chemicals; plastic and synthetic materials; drugs; soaps and detergents; paints and allied products; petroleum refining; engines and turbines; construction, metalworking, and industrial machinery; computer, audio, visual, and office equipment; electrical distribution equipment; communications equipment; electronic components; aircraft and parts; railroad equipment; guided missiles and space vehicles; tanks and components; search and navigation equipment; measuring and controlling devices; medical instruments and supplies; and photographic equipment.

The following sections calculate both the Manufacturing Diversification Index and Specialization Ratios to gauge the robustness of Missouri's manufacturing sector.

II. Manufacturing Diversification Indices

The Manufacturing Diversification Index (MDI) is a simple calculation that measures the distribution of various industries within a particular area – measured by the proportionate distribution of the labor force. MDI is used to examine how well distributed manufacturing employment is between top-of-cycle, bottom-of-cycle, resource-based and high-technology manufacturing. The importance of a diversified manufacturing sector is clear. Many areas within Missouri and the United States have experienced the deleterious effects of being too dependent on a single type of manufacturing. For example, areas heavily dependent on low-skill manual production in the 1980s experienced severe economic hardships when firms eliminated jobs due to automation and relocation to low wage areas abroad.

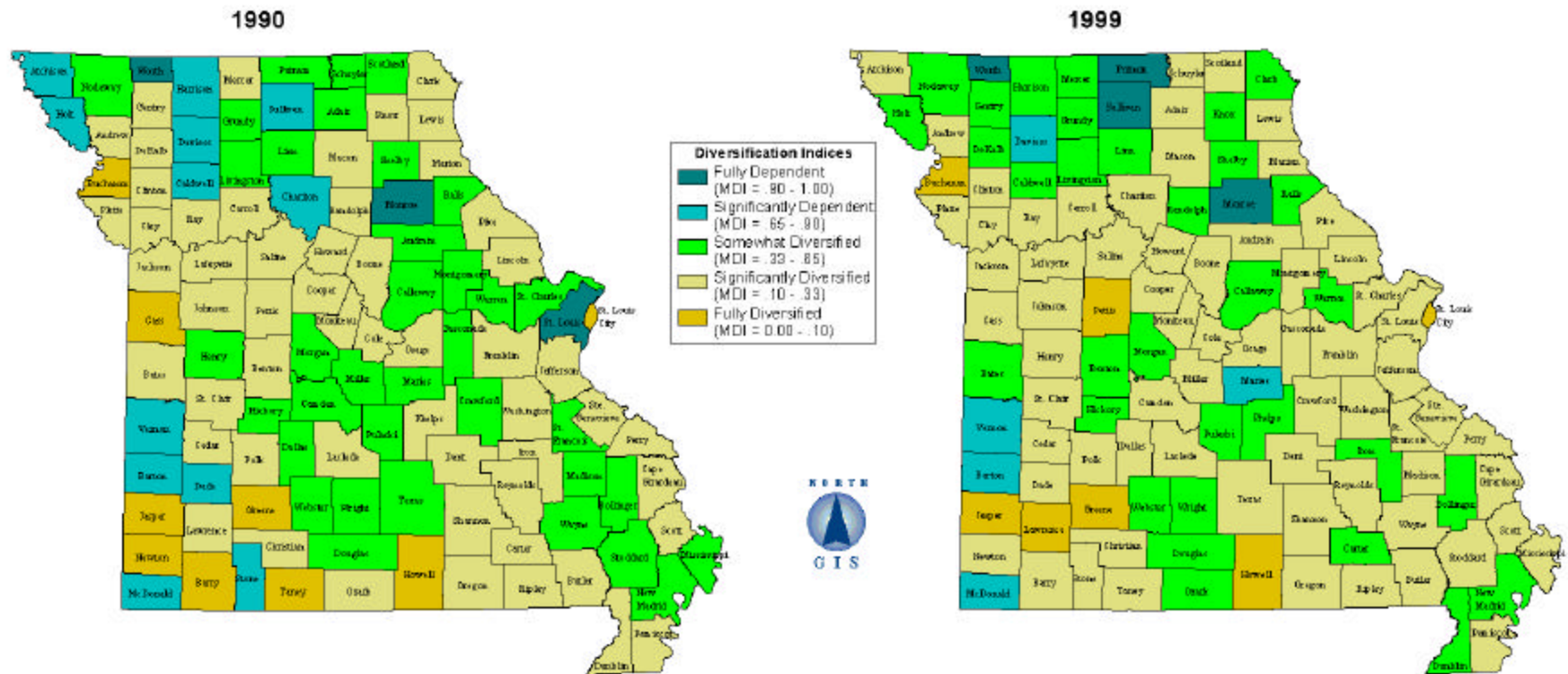
The MDI ranges from 0.0 to 1.0, and measures the distribution of manufacturing employment across the four categories. MDIs of 0.0 indicate that the manufacturing sector is completely diversified – there is an equal percentage of manufacturing employees in all four categories. MDIs of 1.0 indicate that the manufacturing sector is fully dependent on one type of manufacturing – most all manufacturing employees are in one category. In general, lower MDI scores indicate a more diverse manufacturing sector.

$$MDI_{\text{sector}} = \sum_{i=1}^n \left(\frac{n}{n-1} \left(\left(\frac{SECTOR_MFGR_EMPL_{\text{county}}}{TOTAL_MFGR_EMPL_{\text{county}}} \right)^2 - \frac{1}{n} \right) \right)$$

The results show that Missouri has a moderate to significantly diversified manufacturing base (refer to map). This indicates that Missouri's manufacturing economy is relatively robust, and would generally be able to withstand macroeconomic fluctuations. Counties that have a fully diversified manufacturing base include Buchanan, Greene, Howell, Jasper, Lawrence, Pettis and St. Louis City. However, several counties are fully dependent on one type of manufacturing. These are located in the northern portion of Missouri and include Monroe, Putnam, Sullivan and Worth Counties.



Manufacturing Diversification Indices



Measures the degree of diversification or dependence among the following four types of manufacturing: Top-of-Cycle, Bottom-of-Cycle, Resource-Based, and High-Technology.

Source: ES-202, Missouri Department of Economic Development

III. Manufacturing Specialization Ratios

Specialization ratios (SRs), also known as location quotients, are a measure of county employment concentration in a given economic sector relative to the state average. SRs indicate areas of potential economic growth within the county, or a county's comparative advantage in a given sector. Comparing these ratios over time gives an indication of the relative strengths and weaknesses of the manufacturing sector. SRs greater than 1.0 indicate that the county is relatively more specialized in that industry relative to the state as a whole; or that the county has a comparative advantage in that industry. SRs less than 1.0 indicate that the county is relatively less specialized in that industry relative to the state as a whole, which may indicate a potential area for growth; or that the county does not have a comparative advantage in that industry.

$$SR_{\text{sector}} = \frac{\left(\frac{\text{SECTOR_EMPLOYMENT}_{\text{county}}}{\text{TOTAL_EMPLOYMENT}_{\text{county}}} \right)}{\left(\frac{\text{SECTOR_EMPLOYMENT}_{\text{state}}}{\text{TOTAL_EMPLOYMENT}_{\text{state}}} \right)}$$

Generally speaking, SRs compare the percent employed in a given industry within a county relative to the state as a whole. It is important to note that SRs measure the proportion of sector employment relative to the state average, and *not* the total number of jobs. Therefore, although St. Louis may have the largest number of high-technology employees, it accounts for only a small percentage of total employment – leading to a small SR. The following compares SRs for the aggregate manufacturing sectors defined above: top-of-cycle, bottom-of-cycle, resource-based and high-technology.

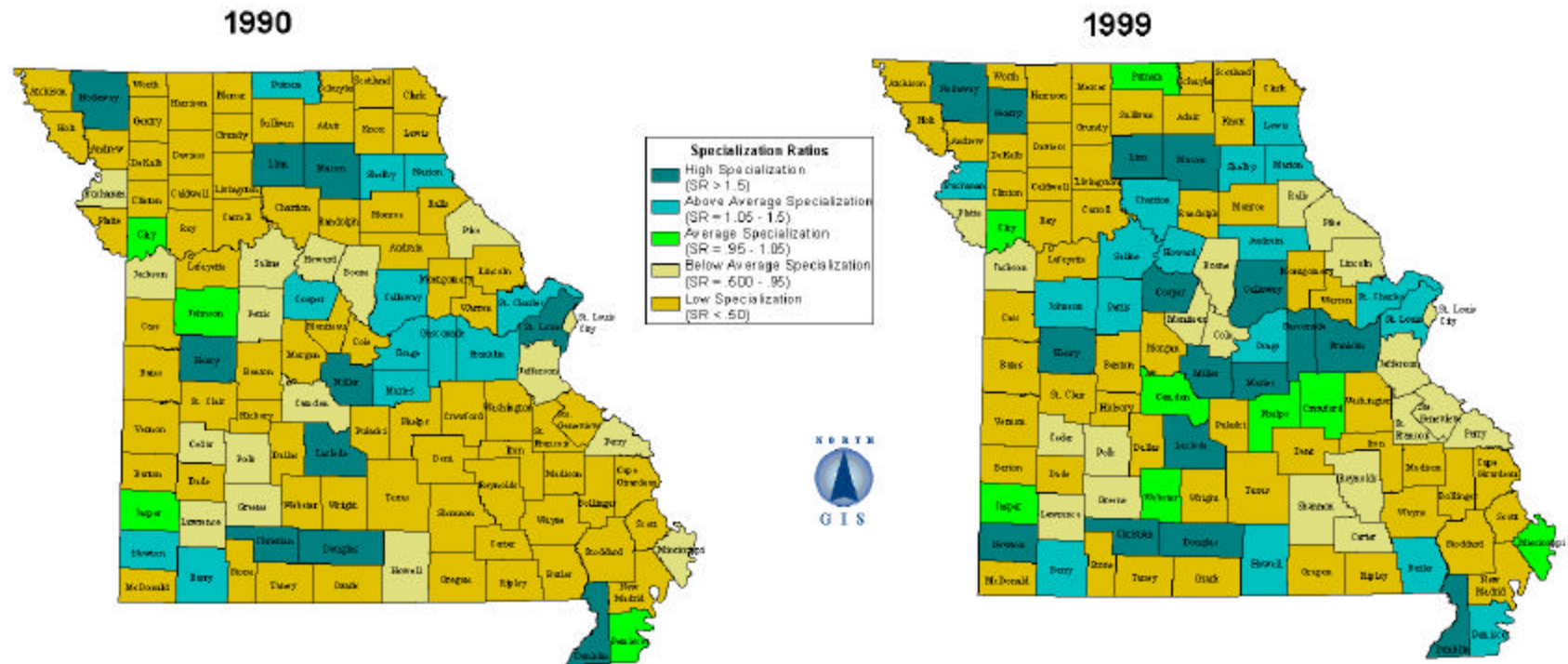
A. Top-of-Cycle Manufacturing

Top-of-cycle manufacturing industries are those that typically require highly skilled technical labor. Between 1990 and 1999, the number of counties that are highly specialized in this type of manufacturing has increased - from 10 in 1990 to 16 in 1999. In 1999, top-cycle manufacturing employment was concentrated in eight areas of the state: (1) the Boonville/Marshall area along Interstate 70 (Cooper and Saline Counties); (2) the Clinton/Warrensburg area (Johnson and Henry Counties); (3) the Missouri River valley area from Jefferson City to St. Louis (Callaway, Gasconade and Franklin Counties); (4) the US 36 corridor from Hannibal to Macon (Macon and Marion Counties); (5) the areas adjacent to Joplin and Springfield (Christian and Newton Counties); (6) the Lake of the Ozarks area (Laclede and Miller Counties); (7) the Maryville area (Nodaway County); (8) the southern portion of the Missouri Bootheel (Dunklin County); and (9) suburban St. Louis (St. Charles and St. Louis Counties).

High specialization in top-cycle manufacturing may produce positive externalities in the community. These include a highly skilled workforce, higher wages, and more jobs that are less prone to relocation abroad and automation. Further, possessing a highly skilled workforce can be an asset in attracting other firms to the county.

In general, the southeastern and northern portions of Missouri have low employment in top-cycle manufacturing, relative to the state average. However, in absolute numbers top-of-cycle manufacturing employment is concentrated in the metropolitan areas of the state. Employment is also moderately concentrated in Columbia/Jefferson City, Lake of the Ozarks, Maryville, Linn County and Hannibal. It is important to note that SRs measure the proportion of sector employment relative to the state average, *not* the total number of jobs. Therefore, although certain metro areas may have the large numbers of top-cycle employees (i.e. Kansas City and Springfield), it accounts for only a small percentage of total employment – leading to a small SR.

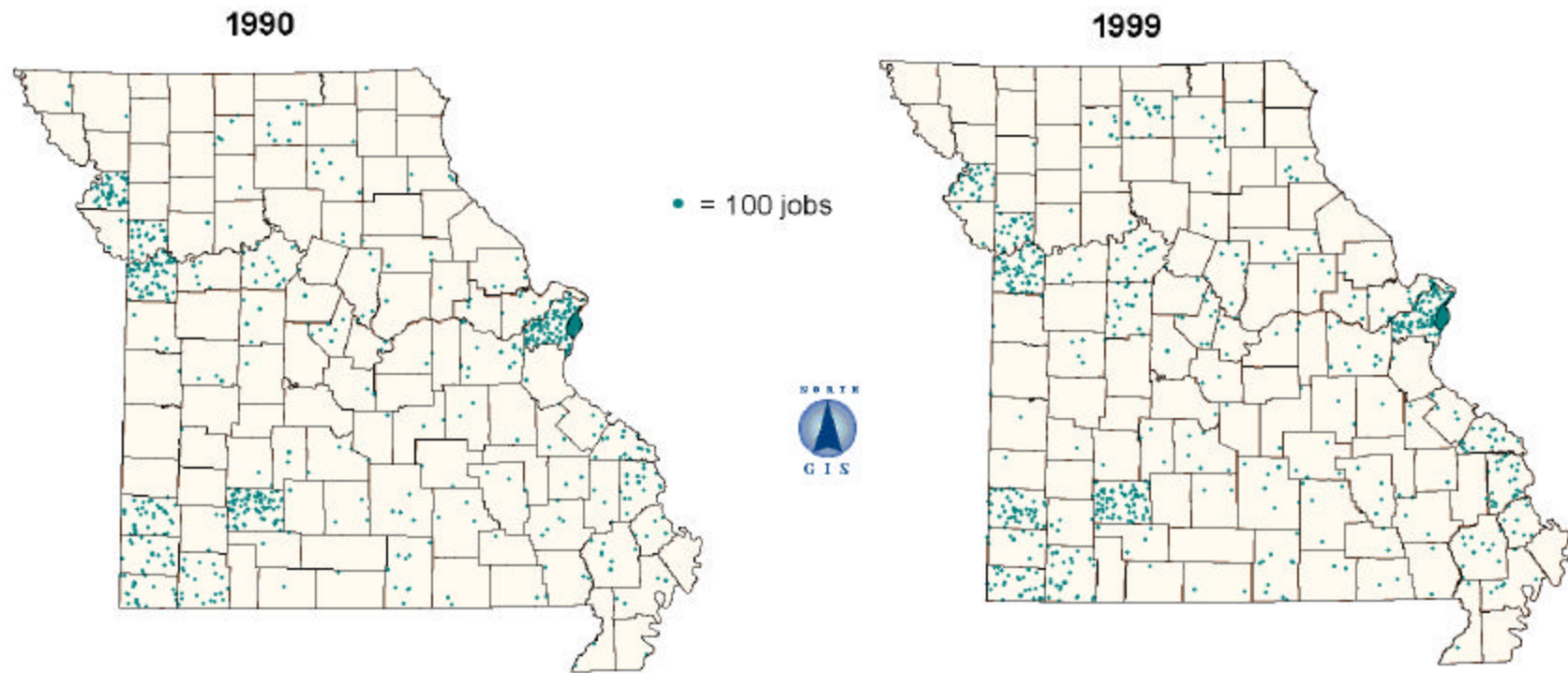
Top-of-Cycle Manufacturing Specialization Ratios



Industries that require highly skilled technical labor. This includes the manufacturing of: printing and publishing; chemicals; machinery; electrical machinery; transportation equipment (excluding motor vehicles); and instruments.

Source: ES-202, Missouri Department of Economic Development

Top-of-Cycle Manufacturing Employment



Industries that require highly skilled technical labor.
This includes the manufacturing of: printing and publishing; chemicals; machinery; electrical machinery; transportation equipment (excluding motor vehicles); and instruments.

Source: ES-202, Missouri Department of Economic Development

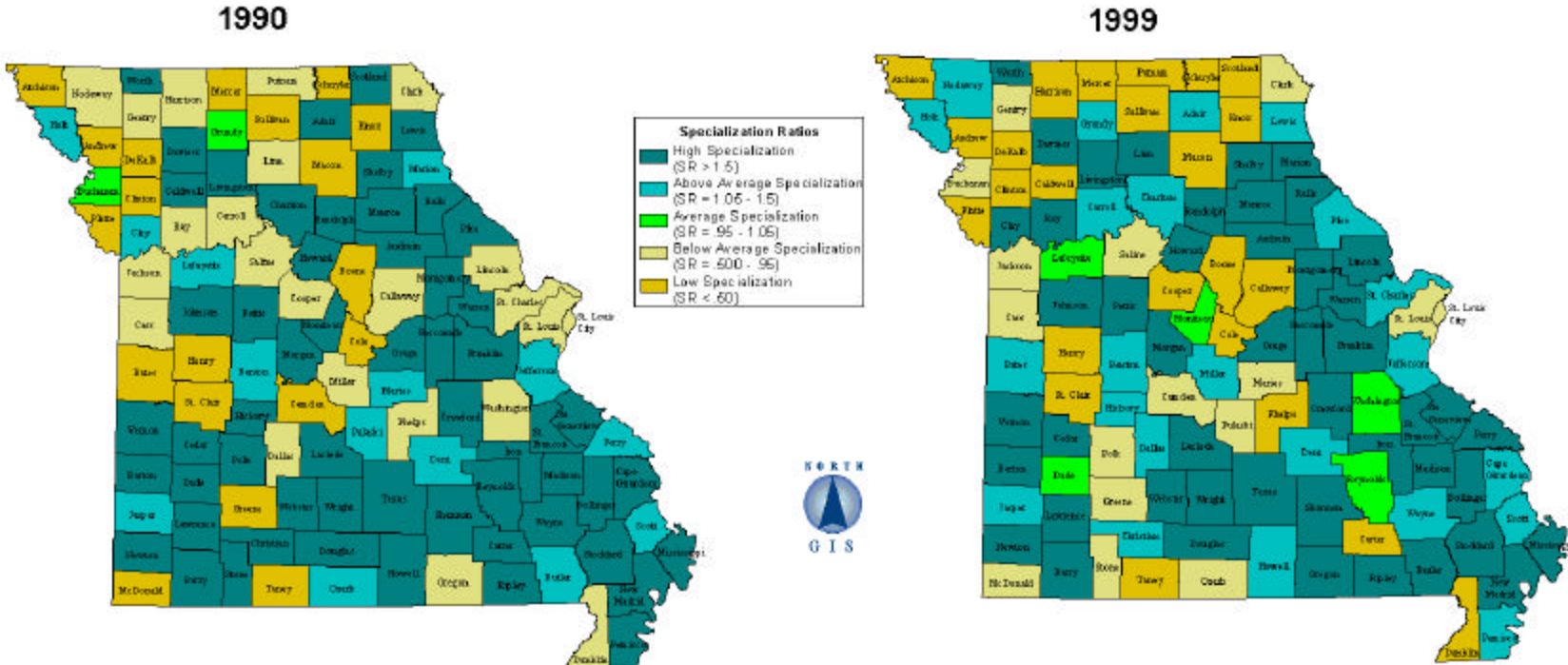
B. Bottom-of-Cycle Manufacturing

Bottom-of-cycle manufacturing industries are those that require assembly and materials handler labor for standardized production. Between 1990 and 1999, the number of counties that are highly specialized in this type of manufacturing has decreased - from 57 in 1990 to 47 in 1999. In 1999, bottom-cycle manufacturing was concentrated in the east-central, southeast, south-central, and southwest regions of the state. Reflecting national trends, declines in this type of manufacturing are due mainly to automation and the movement of operations to lower wage areas abroad. As a result, local economies highly concentrated in bottom-cycle manufacturing may be vulnerable to job losses due to firm relocations.

High specialization in bottom-cycle manufacturing may produce negative externalities in the community. These include a poorly skilled workforce, lower wages, and potential job losses due to relocation abroad and automation. Having a poorly skilled workforce may be a hindrance in attracting high wage employment to the county.

In general, bottom-cycle manufacturing employment is low in the major metropolitan areas, relative to the state average. However, in absolute numbers bottom-of-cycle manufacturing employment is concentrated in the metropolitan areas of the state. The reason for this is that SRs measure the proportion of sector employment relative to the state average, *not* the total number of jobs. Therefore, although metro areas may have the largest number of bottom-cycle employees, it accounts for only a small percentage of total employment – leading to a small SR. Employment is also moderately concentrated in Columbia/Jefferson City, Hannibal, Cape Girardeau and the southeast portion of the state.

Bottom-of-Cycle Manufacturing Specialization Ratios



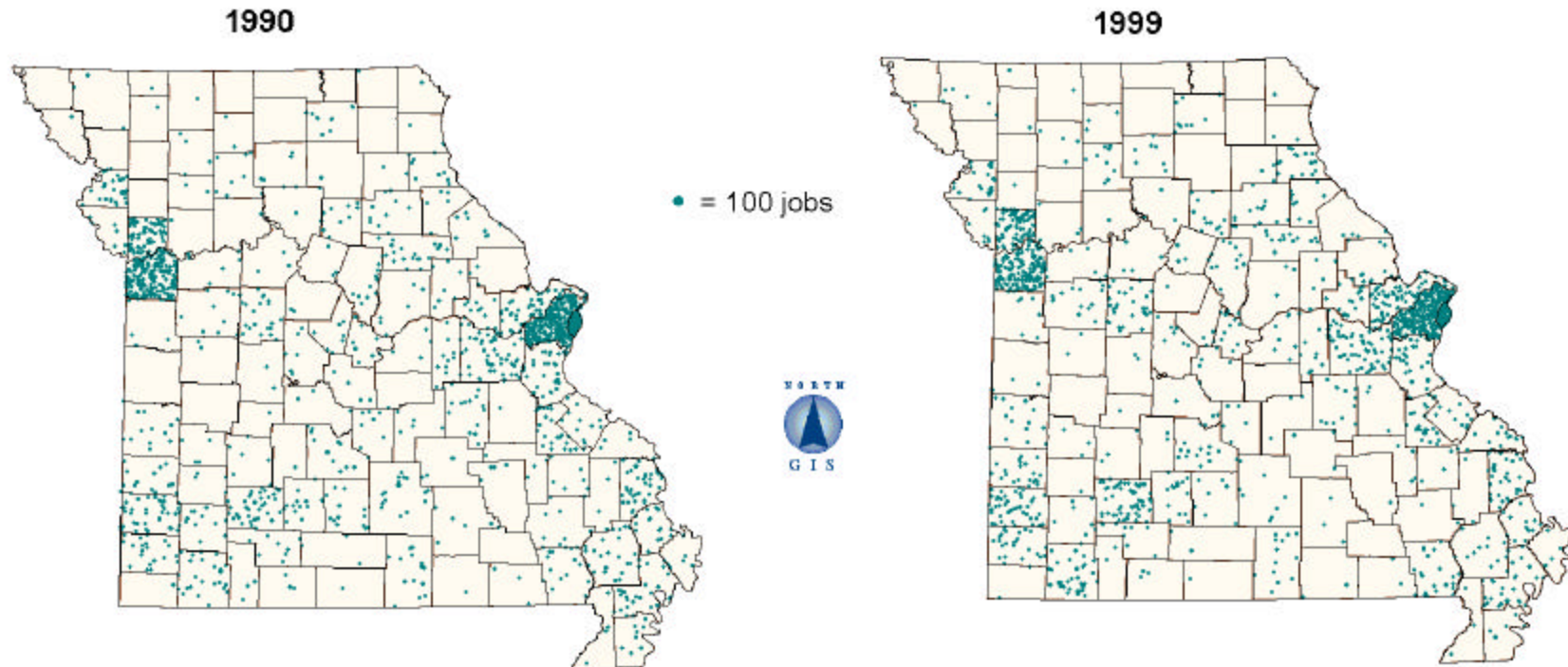
Industries that require assembly and material handler labor for standardized production. This includes the manufacturing of: textiles; apparel; furniture and fixtures; rubber and plastics; leather goods; stone, glass, and clay; primary metals; fabricated metals; and motor vehicles.

Source: ES-202, Missouri Department of Economic Development

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Bottom-of-Cycle Manufacturing Employment



Industries that require assembly and material handler labor for standardized production. This includes the manufacturing of: textiles; apparel; furniture and fixtures; rubber and plastics; leather goods; stone, glass, and clay; primary metals; fabricated metals; and motor vehicles.

Source: ES-202, Missouri Department of Economic Development

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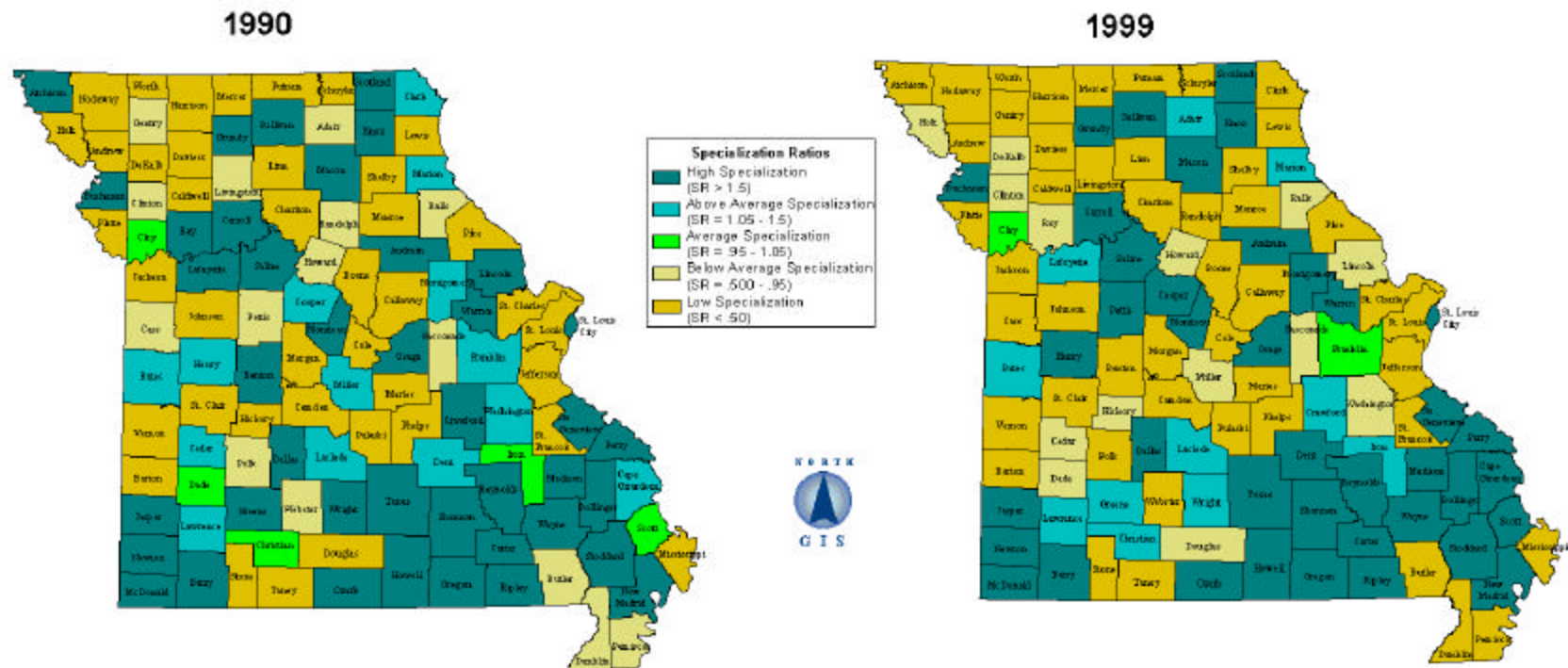
C. Resource-Based Manufacturing

Resource-based manufacturing industries are those that typically require access to natural resources or agricultural products. Between 1990 and 1999, the number of counties that are highly specialized in this type of manufacturing has remained stable - from 41 in 1990 to 40 in 1999. In both years, this type of manufacturing has been concentrated in three main areas of the state. First, the southeast and south-central areas, which are involved mainly in the production of lumber and wood products. Second, the southwest corner of the state is involved in food processing. Third, counties in the central and northern regions of the state are primarily involved in agricultural and food processing. Additionally, Buchanan County in the western edge of the state is primarily involved in tobacco production.

In general, manufacturing of this type is relatively dependent on access to agricultural and natural resources. Areas without these resources would be hard pressed to develop the resource-based manufacturing sector.

In terms of absolute numbers, resource-based manufacturing employment is concentrated in the metropolitan areas of the state. The reason for this is that SRs measure the proportion of sector employment relative to the state average, *not* the total number of jobs. Therefore, although metro areas have the largest number of resource-based employees, it accounts for only a small percentage of total employment – leading to a small SR. Employment is also moderately concentrated in Cape Girardeau, the Marshall/Sedalia area, Sullivan County in northern Missouri, and in the southwest corner of the state.

Resource-Based Manufacturing Specialization Ratios



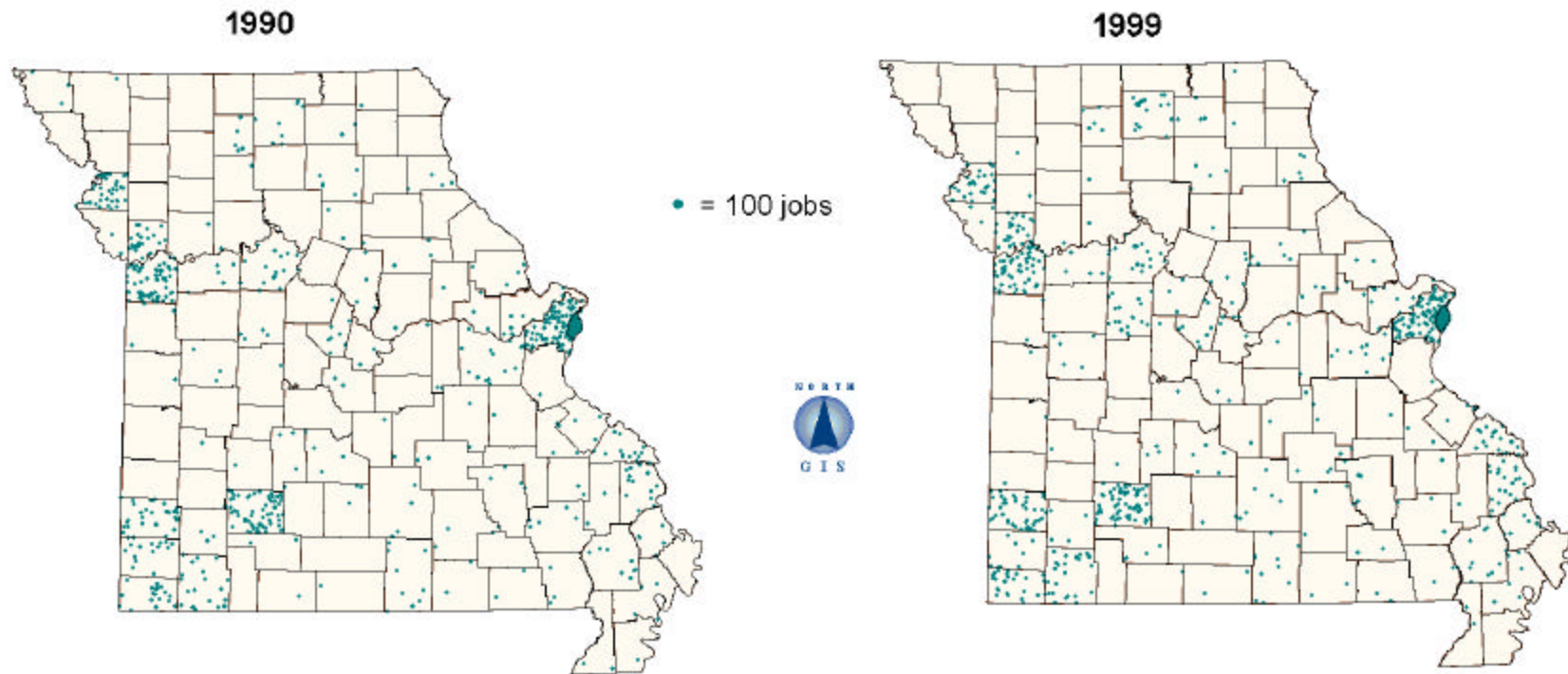
Industries that require access to natural resources or agricultural products. This includes the manufacturing of: food products; tobacco products; lumber and wood products; paper; and petroleum and coal products.

Source: ES-202, Missouri Department of Economic Development

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Resource-Based Manufacturing Employment



Industries that require access to natural resources or agricultural products. This includes the manufacturing of: food products; tobacco products; lumber and wood products; paper; and petroleum and coal products.

Source: ES-202, Missouri Department of Economic Development

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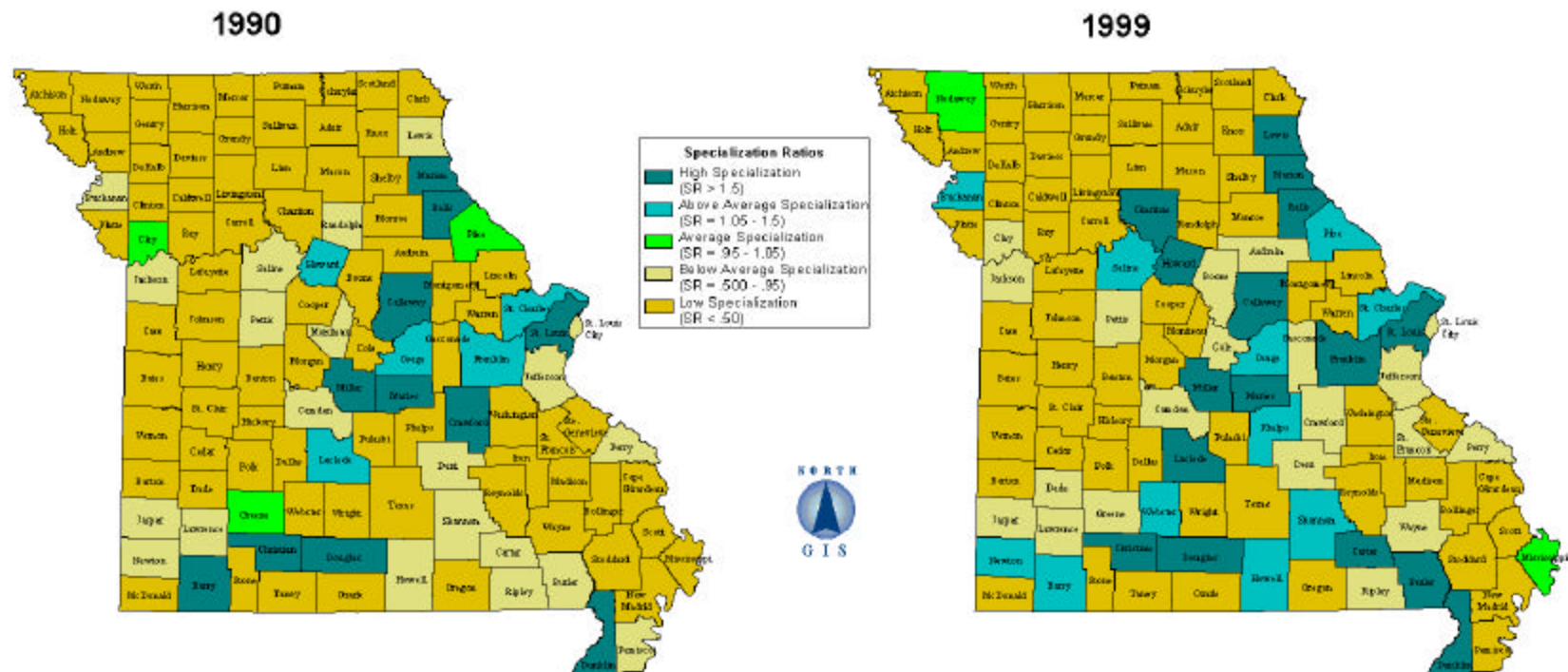
D. High-Technology Manufacturing

High-technology manufacturing industries are those that require an above average number of engineers, engineering technicians, mathematicians, computer scientists, and life scientists (including chemists and geologists). Between 1990 and 1999, the number of counties that are highly specialized in this type of manufacturing has increased - from 11 in 1990 to 16 in 1999. In 1999, high-tech manufacturing was concentrated in seven areas of the state: (1) the agricultural region of Chariton and Howard Counties; (2) the Hannibal region (Lewis, Marion and Ralls Counties); (3) suburban St. Louis (Franklin and St. Louis Counties); (4) Fulton (Callaway County); (5) the Lake of the Ozarks region (Laclede, Maries and Miller Counties); (6) the area adjacent to Springfield (Christian and Douglas Counties); and (7) the Popular Bluff region (Butler, Carter and Douglas Counties). In general, the northern, western and southeastern portion of Missouri have low concentrations of high-tech employment, relative to the state as a whole.

High specialization in high-technology manufacturing may produce positive externalities in the community. These include a highly skilled workforce, higher wages, and jobs that are less prone to relocation abroad and automation. Further, possessing a highly skilled workforce can be an asset in attracting other firms to the county.

In terms of absolute numbers, high-technology manufacturing employment is concentrated in the metropolitan areas of the state – contrary to their SRs. The reason for this is that SRs measure the proportion of sector employment relative to the state average, *not* the total number of jobs. Therefore, although metro areas may have the largest number of high-technology employees, it accounts for only a small percentage of total employment – leading to a small SR. Employment is also moderately concentrated in the Fulton/Jefferson City area, Hannibal, Popular Bluff and Rolla.

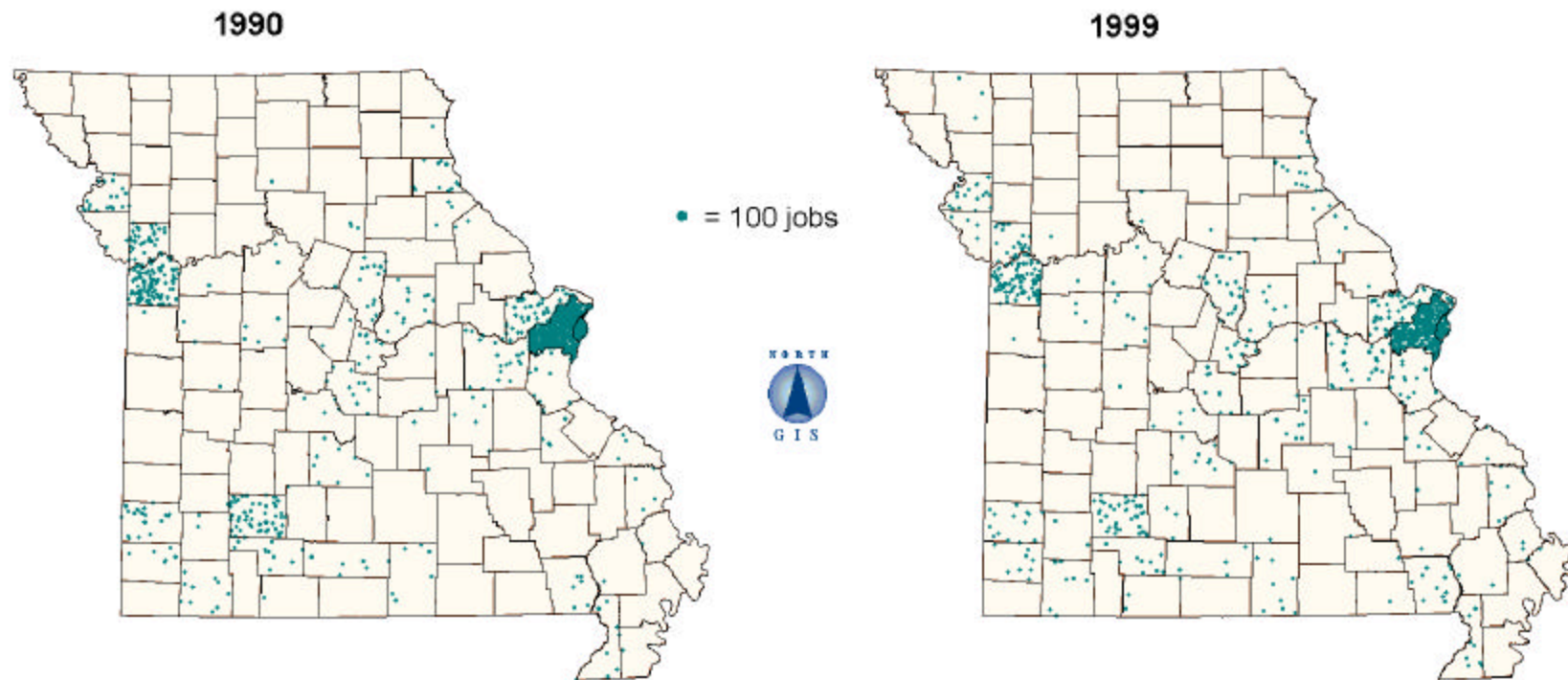
High-Technology Manufacturing Specialization Ratios



Industries that require a significant number of engineers, engineering technicians, computer scientists, mathematicians, and life scientists (including chemists and geologists). This includes the manufacturing of: industrial inorganic, organic and agricultural chemicals; plastics; drugs; soaps and detergents; paints; petroleum refining; engines and turbines; machinery; computer, electrical, and communications equipment; aircraft; missiles and space vehicles; tanks; navigation equipment; scientific and medical instruments; and photographic equipment.

Source: ES-202, Missouri Department of Economic Development

High-Technology Manufacturing Employment



Industries that require a significant number of engineers, engineering technicians, computer scientists, mathematicians, and life scientists (including chemists and geologists). This includes the manufacturing of: industrial inorganic, organic and agricultural chemicals; plastics; drugs; soaps and detergents; paints; petroleum refining; engines and turbines; machinery; computer, electrical, and communications equipment; aircraft; missiles and space vehicles; tanks; navigation equipment; scientific and medical instruments; and photographic equipment.

Source: ES-202, Missouri Department of Economic Development



IV. Summary

The manufacturing sector still constitutes an important part of local and regional economies in the United States, especially in rural areas. Given the nature of the global economy, policy-makers need to identify areas of economic comparative advantage that they can build upon; and areas of economic vulnerability that they need to strengthen. It is important to understand that manufacturing is a diverse industry in terms of both the products it produces and the labor skills it requires – it cannot be conceptualized as a homogenous sector.

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Between 1990 and 1999, the number of counties that are highly specialized in *bottom-of-cycle manufacturing* has decreased - from 57 in 1990 to 47 in 1999. In 1999, bottom-cycle manufacturing was concentrated in the east-central, southeast, south-central, and southwest regions of the state. Reflecting national trends, declines in this type of manufacturing are due mainly to automation and the movement of operations to lower wage areas abroad. As a result, local economies highly concentrated in bottom-cycle manufacturing may be vulnerable to job losses due to firm relocations. In general, bottom-cycle manufacturing employment is low in the major metropolitan areas, relative to the state average.

Between 1990 and 1999, the number of counties that are highly specialized in *resource-based manufacturing* has remained stable - from 41 in 1990 to 40 in 1999. In both years, this type of manufacturing has been concentrated in three

main areas of the state. First, the southeast and south-central areas are involved mainly in the production of lumber and wood products. Second, the southwest corner of the state is involved in food processing. Third, counties in the central and northern regions of the state are primarily involved in agricultural and food processing. Additionally, Buchanan County in the western edge of the state is primarily involved in tobacco production.

Between 1990 and 1999, the number of counties that are highly specialized in *high-technology manufacturing* has increased - from 11 in 1990 to 16 in 1999. In 1999, high-tech manufacturing was concentrated in seven areas of the state: (1) the agricultural region of Chariton and Howard Counties; (2) the Hannibal region; (3) suburban St. Louis; (4) Fulton; (5) the Lake of the Ozarks region; (6) the area adjacent to Springfield; and (7) the Popular Bluff region. In general, the northern, western and southeastern portion of Missouri have low concentrations of high-tech employment, relative to the state as a whole.

Ultimately, different types of manufacturing produce different types of positive and negative externalities. For example, manufacturing firms that require a high degree of skilled technical labor may produce a more educated workforce, higher wages, and globally competitive jobs that are secure. In contrast, firms that require little or no skilled labor may produce a poorly educated workforce, lower wages, and jobs that are prone to be moved to low wage nations abroad. Therefore, it is important that policy-makers understand the types of manufacturing that exist in their area in order to assess these potential economic and external effects.

V. Appendix

SIC CODE

INDUSTRY

TOP-OF-CYCLE MANUFACTURING

27	Printing, publishing and allied industries
28	Chemicals and allied products
35	Machinery, except electrical
36	Electrical machinery
37 (exclude 371)	Transportation equipment (except motor vehicles and equipment)
38	Instrument and related products

BOTTOM-OF-CYCLE MANUFACTURING

22	Textile mill products
23	Apparel and other textile products
25	Furniture and fixtures
30	Rubber and miscellaneous plastics products
31	Leather and leather products
32	Stone, clay and glass products
33	Primary metal industries
34	Fabricated metal products
371	Motor vehicles and equipment
39	Miscellaneous manufacturing industries

RESOURCE-BASED MANUFACTURING

20	Food and kindred products
21	Tobacco products
24	Lumber and wood products
26	Paper and allied products
29	Petroleum and coal products



SIC CODE**INDUSTRY****HIGH TECHNOLOGY INDUSTRIES**

281-	Industrial inorganic chemicals
282-	Plastics materials and synthetics
283-	Drugs
284-	Soap, cleaners, and toilet goods
285-	Paints and allied products
286-	Industrial organic chemicals
287- (exclude 2874)	Agricultural Chemicals
289-	Miscellaneous chemical products
291-	Petroleum refining
3069	Fabricated rubber products, not elsewhere classified
351-	Engines and turbines
353-	Construction and related machinery
354-	Metalworking machinery
356-	General industrial machinery
357-	Computer and office equipment
361-	Electric distribution equipment
362-	Electrical industrial apparatus
365-	Household audio and video equipment
366-	Communications equipment
367-	Electronic components and accessories
372-	Aircraft and parts
374-	Railroad equipment
376-	Guided missiles, space vehicles, parts
3795	Tanks and tank components
381-	Search and navigation equipment
382-	Measuring and controlling devices
384-	Medical instruments and supplies
386-	Photographic equipment and supplies

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